Alg. 2 Warm Up #5-4

Evaluate the logarithms:

1. $\log_5 1$

2. $\log_3 \frac{1}{27}$

3. $\log_{1/2} 16$

4. Condense:

$2\log_3 x + \log_3(x-3)$

5. Expand:

$\log_4\left(\frac{5x}{n^2}\right)$

HW Questions:

6-138. A rule-of-thumb used by car dealers is that the trade-in value of a car decreases by 20% of its value each year.

a. Explain how the phrase "decreases by 20% of its value each year" tells you that the trade-in value varies exponentially with time (i.e., can be represented by an exponential function).

b. Suppose the initial value of your car is \$23,500. Write an equation expressing the trade-in value of your car as a function of the number of years from now.

$y = 23{,}500(0.8)^x$

c. How much will your car be worth in four years?

d. In how many years will the trade-in value of your car be \$6000?

$6000 = 23{,}500(0.8)^x$

e. If your car is really 2.7 years old now, what was its trade-in value when it was new? $\rightarrow$ $y = 23{,}500(0.8)^{-2.7}$

6-139. Solve for x without using a calculator.

a. $x = \log_{25}(5)$ → $25^x = 5$

$(5^2)^x = 5^1$

$2x = 1$

$x = \frac{1}{2}$

b. $\log_x(1) = 0$

c. $23 = \log_{10}(x)$

6-140. Using your calculator, solve the equations below. Round answers to the nearest 0.001.

a. $x^6 = 125$

b. $x^{3.8} = 240$

c. $x^{-4} = 100$

d. $(x+2)^3 = 65$

e. $4(x-2)^{12.5} = 2486$

$(x^{3.8})^{1/3.8} = (240)^{1/3.8}$

6-141. If $f(x) = x^4$ and $g(x) = 3(x+2)$, find the value of each expression below.

a. $f(2)$

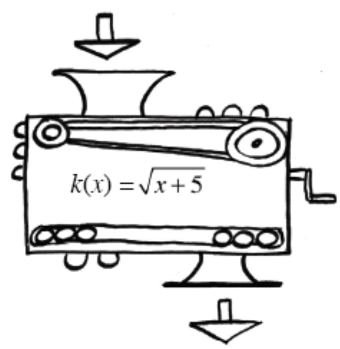
b. $g(2)$

c. $f(g(2))$

d. $g(f(2))$

e. Are $f(x)$ and $g(x)$ inverses of each other? Justify your answer.

6-142. Kirsta was working with the function machine shown at right, but when she turned her back, her little brother Caleb dropped in a number. She didn't see what he dropped, but she did see what fell out: 9. What operations must she perform on 9 to undo what her machine did? Use this to find out what Caleb dropped in.



6-143. Write an equation for a machine that will undo Kirsta's machine. Call it $c(x)$.

6-144. What is the equation of the line of symmetry for the graph of $y=(x-17)^2$? Justify your answer.

6-145. This problem is a checkpoint for adding and subtracting rational expressions. It will be referred to as Checkpoint 6B.

Add or subtract each pair of rational expressions. Simplify the result.

a. $\frac{4}{x^2+5x+6}+\frac{2x}{x+2}\frac{(x+3)}{(x+3)}$

$(x+2)(x+3)$

$\frac{4+2x^2+6x}{(x+2)(x+3)}$

$\frac{2x^2+6x+4}{(x+2)(x+3)}$

$\frac{2(x^2+3x+2)}{(x+2)(x+3)}$

$\frac{2\cancel{(x+2)}(x+1)}{\cancel{(x+2)}(x+3)}$

$\frac{2(x+1)}{(x+3)}$

b. $\frac{3x^2+x}{(2x+1)^2}-\frac{3}{2x+1}\frac{(2x+1)}{(2x+1)}$

$\frac{3x^2+x-3(2x+1)}{(2x+1)^2}$

$\frac{3x^2-5x-3}{(2x+1)^2}$

Blue CP's, check answers:

1) $x = 7$
2) $x = -\frac{8}{9}$
3) $x = -\frac{28}{3}$
4) $x \approx 2.32$
5) $x \approx -0.19$
6) $x \approx 0.40$
7) $\log_5 15$
8) $\log_3(4x^2 + 8x)$

9) $\log_b\left(\frac{9}{x}\right)$

Solve the system on the back:

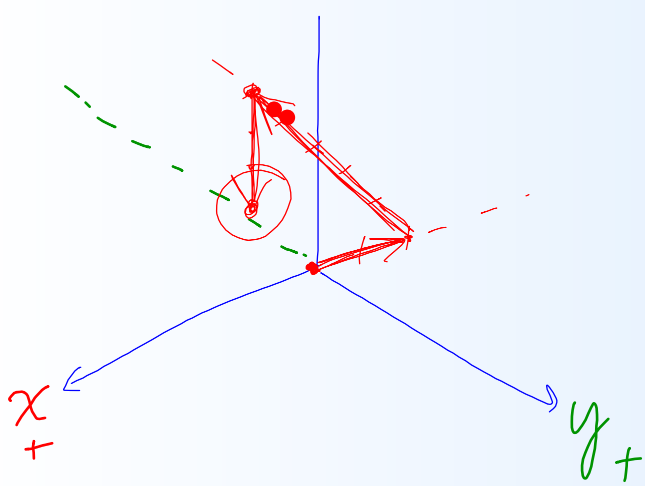
* Best choice is to eliminate z

answer:

$(-3, 5, 1)$

Blue CP's, questions:

12) $(-2, -5, -3)$



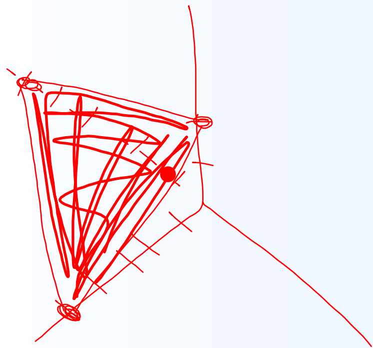
Blue CP's, questions:

15) $2x - 2y + 5z = 10$

x-int: $(5, 0, 0)$

y-int $(0, -5, 0)$

z-int $(0, 0, 2)$



Review: $y = ab^x$

Passes through: $(\overset{x}{3}, \overset{y}{19.2})$ and $(\overset{x}{6}, \overset{y}{153.6})$

$$19.2 = ab^3 \qquad \frac{153.6}{19.2} = \frac{\cancel{a}b^6}{\cancel{a}b^3}$$

$$\sqrt[3]{8} = \sqrt[3]{b^3}$$

$$b = 2$$

$$\frac{19.2}{8} = \frac{a(2)^3}{8}$$

$$a = 2.4$$

$$y = 2.4(2)^x$$

Review: $y = ab^x$

Passes through: ($\overset{x}{3}$, $\overset{y}{19.2}$) and (6, 153.6)

$$19.2 = ab^3$$

$$\frac{19.2}{8} = \frac{a(2)^3}{8}$$

$$a = 2.4$$

$$\frac{153.6}{19.2} = \frac{\cancel{a}b^6}{\cancel{a}b^3}$$

$$8 = b^3$$

$$b = 2$$

$$y = 2.4(2)^x$$

CP's: 6- # 123 ---> 125

6.2.3 How can I find an exponential function?

Writing Equations of Exponential Functions

You have worked with exponential equations throughout this chapter. Today you will look at how you can find the equation for an exponential function using data.

6-123. DUE DATE

Brad's mother has just learned that she is pregnant! Brad is very excited that he will soon become a big brother. However, he wants to know when his new sibling will arrive and decides to do some research. On the Internet, he finds the following article:

> **Hormone Levels for Pregnant Women**
>
> When a woman becomes pregnant, the hormone HCG (human chorionic gonadotropin) is produced to enable the baby to develop.
>
> During the first few weeks of pregnancy, the level of HCG hormone grows exponentially, starting with the day the embryo is implanted in the womb. However, the rate of growth varies with each pregnancy. Therefore, doctors cannot use just a single test to determine how long a woman has been pregnant. They must test the levels over time. Commonly, the HCG levels are measured two days apart to look for this rate of growth.

Brad's mother says she was tested for HCG during her last two doctor visits. On March 21, her HCG level was 200 mIU/ml (milli-international units per milliliter). Two days later, her HCG level was 392 mIU/ml.

a. Assuming that the model for HCG levels is of the form $y = ab^x$, find an equation that models the growth of HCG for Brad's mother's pregnancy.

b. Assuming that Brad's mother's level of HCG on the day of implantation was 5 mIU/ml, on what day did the baby most likely become implanted? How many days after implantation was his mother's first doctor visit?

c. Brad learned that a baby is born approximately 37 weeks after implantation. When can Brad expect his new sibling to be born?

a) If $x = 0$ on March 21 → (0, 200) (2, 392)

$$200 = ab^0$$
$$a = 200$$

$$392 = 200(b)^2$$
$$\frac{392}{200} = b^2$$
$$1.96 = b^2$$
$$1.4 = b$$

$$y = 200(1.4)^x$$

6-124. SOLVING STRATEGIES

In problem 6-123, you and your team developed a strategy to find the equation of an exponential equation of the form $y = ab^x$ when given two points on the curve.

a. What different strategies were generated by the other teams in your class? If no one shares your solving method with the class, be sure to share yours. Take notes on the different strategies that are presented.

b. Did any team use a system of exponential equations to solve for a and b? If not, examine this strategy as you answer the questions below.

i. The doctor visits provide two data points that can help you find an exponential model: $(21, 200)$ and $(23, 392)$. Use each of these points to substitute for x and y into $y = ab^x$. You should end up with two equations in terms of a and b.

ii. Consider the strategies you already have for solving systems of equations. Are any of those strategies useful for this problem? Discuss a way to solve your system from part (i) for a and b with your team. Be ready to share your method with the class.

6-125. The context in problem 6-123 required you to assume that the exponential model had an asymptote at $y = 0$ to find the equation of the model. But what if the asymptote is not at the x-axis? Consider this situation below.

a. Assume the graph of an exponential function passes through the points $(3, 12.5)$ and $(4, 11.25)$. Is the exponential function increasing or decreasing? Justify your answer.

b. If the horizontal asymptote for this function is the line $y = 10$, make a sketch of its graph showing the horizontal asymptote.

c. If this function has the equation $y = ab^x + c$, what would be the value of c? Use what you know about this function to find its equation. Verify that as x increases, the values of y get closer to $y = 10$.

d. Find the y-intercept of the function. What is the connection between the y-intercept and the asymptote?

6-126. Janice would like to have \$40,000 to help pay for college in 8 years. Currently, she has \$1000. What interest rate, when compounded yearly, would help her reach her goal?

a. What type of function would best model this situation? Explain how you know and write the general form of this function.

b. If y represents the amount of money and x represents the number of years after today, find an equation that models Janice's financial situation. What interest rate does she need to earn?

c. Janice's friend Sarah starts with \$7800 and wants to have \$18,400 twenty years from now. What interest rate does she need (compounded yearly)?

d. Is Janice's goal or Sarah's goal more realistic? Justify your response.

Get organized and staple up:

<u>Week 5 Classwork</u>

Warm up on top

6 - # 88 ---> 93

6 - # 104 ---> 106

6 - # 108 ---> 111 (with log resource pg)

Blue Classwork

6 - # 123 ---> 125

HW:

6- #130 ---> 136

Quiz tomorrow:

Graphing a point and
an equation in 3 variables.

Solving a 3 variable system.